The Safety Sigma

Mission Readiness through Operational Safety

A PRODUCT OF THE NAVAL SCHOOL OF AVIATION SAFETY

FROM THE DIRECTOR—HAZARDS AND THREATS: ARE THEY EQUAL?

Hazards

Operational Safety and Safety Management Systems are highly dependent on Risk Management as a way to reduce mishaps. The idea is if you properly manage risk, you can achieve a higher state of readiness at the same cost. Naval Aviation's primary risk management tool is Operation Risk Management (ORM). With the three levels (in-depth, deliberate, and time-critical), the four principles (accept risk when the benefit is greater than the risk, accept no unnecessary risk, anticipate and manage risk by planning, make risk decisions at the right level) and five steps (identify hazards, assess hazards, make risk decisions, implement controls, supervise), ORM reduces risk by identifying and controlling hazards. What is this concept of "hazards" and is it an appropriate term? Since I grew up in the 70s and 80s, when I hear the word "hazard" I always think of Hazzard County, with Bo and Luke Duke (and Daisy of course). But I digress; that of course isn't what kind of "hazards" we are trying to control in ORM. As defined by ORM, a hazard is a "condition with the potential to cause illness, injury, death, property damage or mission degradation." To put it more simply, what we are trying to identify are things that can hurt us, break our aircraft or even kill us. Wow, that actually sounds pretty threatening to me.

Threats

In Naval Aviation threats are numerous. I as a Maritime Patrol Aviator had to consider surface threats, subsurface threats and sometimes air-to-air threats. These threats were always thoroughly briefed. We developed, trained and practiced TTPs against these threats. In the simulator the entire crew would go through numerous scenarios to increase crew coordination in various tactical environments. That's how we handled the Red Threat. I think we all have to be fairly happy about how we continually reinforce and supervise our controls on the Red Threat, but what about the Blue Threat? Do we have well-developed TTPs that we train and practice to combat the Blue Threat? From FY02 through FY13 Naval Aviation lost 178 aircraft and 212 aircrew to the Blue Threat. That is a significant number of losses. Losses during the same period to the Red Threat pale in

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comparison. Based on some quick empirical evidence we could reasonably say that hazards can be and are often more lethal than threats. Is that really true or are we incorrectly labeling our greatest threats as just "hazards," or one of my other favorite terms "latent failures." (OBTW: Some latent failures can kick the crap out of you and take you down faster than an SA-15)

Tactical Risk Management (TRM)

In the paper "Tactical Risk Management– Defeating the Blue Threat" by CAPT Kenneth "Nubs" Neubauer, USN (ret), Nubs discusses how to bring the Weapons and Tactics Instructor (WTI, i.e. Red Threat expert) together with the ASO (Blue Threat expert) through a Tactical Risk Management educational package at MAWTS-1. To quote Nubs, "if we could introduce safety and risk management concepts to the tactical leaders of the Marine Corps in a new way, a way that causes them to view asset preservation as vital to mission success, they would then become allies of the squadron safety professionals." I think that this approach is a unique way in which both the Blue and Red Threat risk can be reduced. We bring our training and tactics expert (WTI) together with our ORM, human factors, SMS and safety culture expert (ASO) and we address the two threats in a methodical, coordinated way. This partnership can help incorporate safety and risk management into everything we do.

Human Factors

DoDHFACS is based on Reason's Swiss Cheese model of accident causation (Figure 1) in which accidents are not due solely to unsafe acts but are also caused by some latent failures at the preconditions, supervisory or organization levels. Often (as many as 90%) operator-related unsafe acts are directly related to Crew Resource Management. In the first 10 years of this millennium we see a large portion of the CRM-related causal factors tied closely to mission planning, communication, or failure to provide cross check/back-up (Figure 2, next page). In fact you could say that 116 mishaps may have been prevented if these causal factors or latent failures were mitigated with controls that were properly supervised.

If you look in-depth at the DoDHFACS, you can see numerous Blue Threats throughout the system. Many of these Blue Threats can be combated through the utilization of CRM and ORM as some of our primary defenses against the Blue Threat (Figure 3, next page). When CRM and ORM are utilized effectively, better risk decisions are made in the time-critical realm.

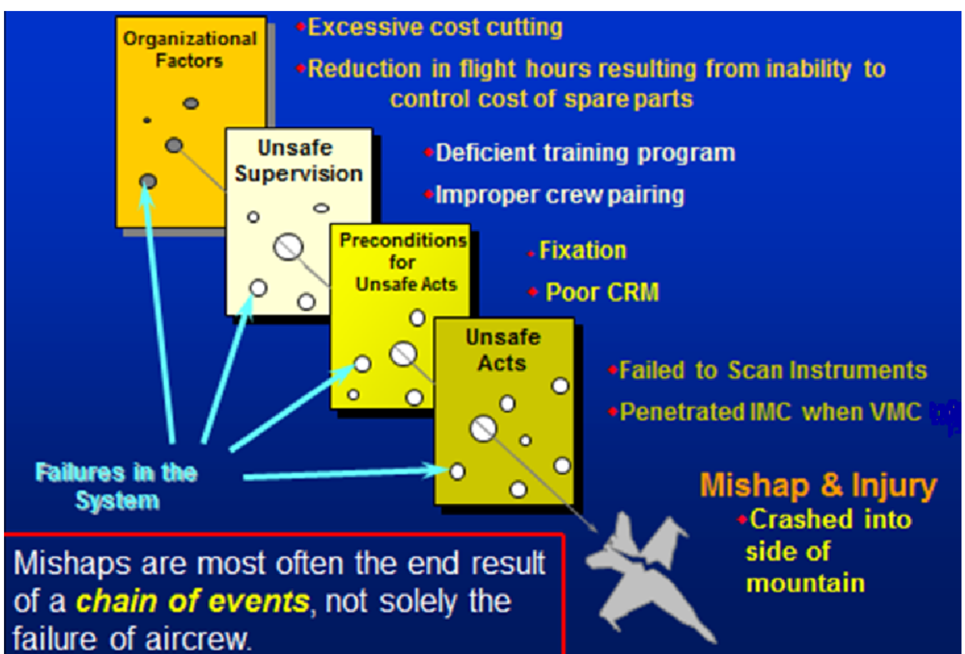

Figure 1. *"Swiss Cheese Model" of accident causation adapted from Reason (1990).*

Time Critical Risk Management (TCRM)

Currently our tool to make risk decisions in the time-critical realm is the ABCD mnemonic: Assess, Balance, Communicate, Do and Debrief. While I think that ABCD does give Sailors and Marines a good baseline on how to conduct time-critical risk management, I am unsure as to how well our ABCD model fits into CRM scenarios where change can happen faster than we can assess the risk and balance our resources. Often in these dynamic evolutions we rely on the OODA loop of tactical decision making, but how well does the OODA loop complement the synergy of teamwork that good CRM is designed to improve. (over)

In order to combat the Blue Threat we need to increase the decision-making ability of our aircrews; while doing that we also address the Red Threat. Blue and Red Threat defenses should not be bifurcated; they need to be addressed in a holistic approach.

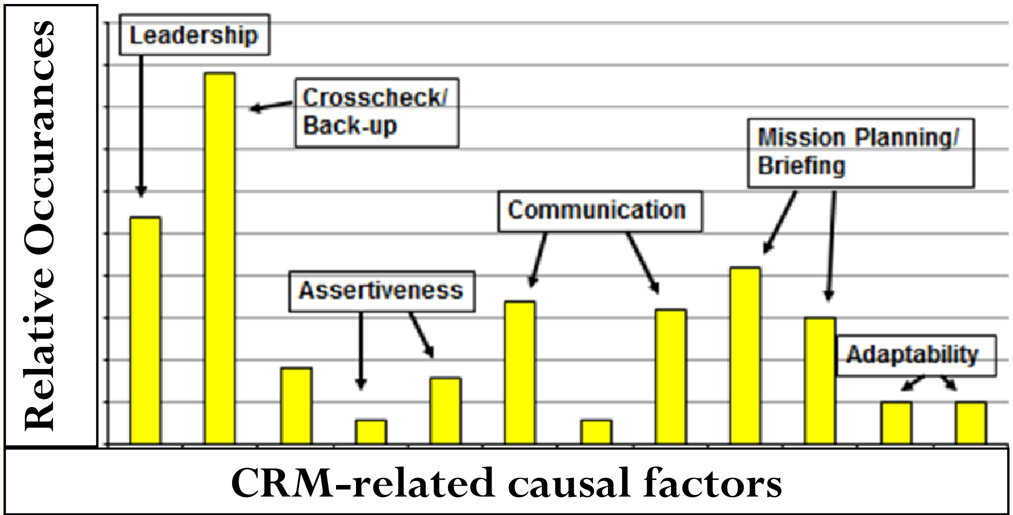

Figure 2. HFACS 2000-2009

Figure 3. Blue Threat Mitigation Strategies

Threat & Error Management (TEM)

One of the newer developments in CRM is the advent and application of Threat and Error Management.

The idea is that all the latent failures in the Swiss Cheese Model are threats. Poor community, squadron, or safety culture, poor scheduling, and vague policies are seen as "latent threats." Environmental, organizational, individual, and team/crew factors are "overt threats." These threats are addressed through threat management strategies and countermeasures in our mission planning and briefing. The next piece of TEM is Error Management. The concept concedes that errors will be made, focusing not just on preventing human error but identifying when an error happens, "capturing" the error, and returning the situation, crew, or aircraft to its desired state. Personally, I think TEM's greatest application to military aviation is that it encourages all threats to be treated equally. Blue Threat mission planning isn't relegated to something administrative, or less important. Equating the importance of the Blue Threat with the Red Threat would hopefully combat the attitude of "can-do easy," which marginalizes how dangerous the Blue Threat really is.

The TEM TRIAD

So now that we understand that hazards are threats, that the Blue Threat has caused more losses of aircraft and lives than the Red Threat, what tools can we put in place? Commanders have three specialists within their squadrons that can become a guiding coalition on improving our crews' ability to accomplish the mission with minimal loss of aircraft or life. They are the ASO, WTI and CRM experts within your squadron (Figure 4, next page). By working together they can fully implement TEM within a squadron in order to address the Blue and Red Threats. (Figure 5, next page).

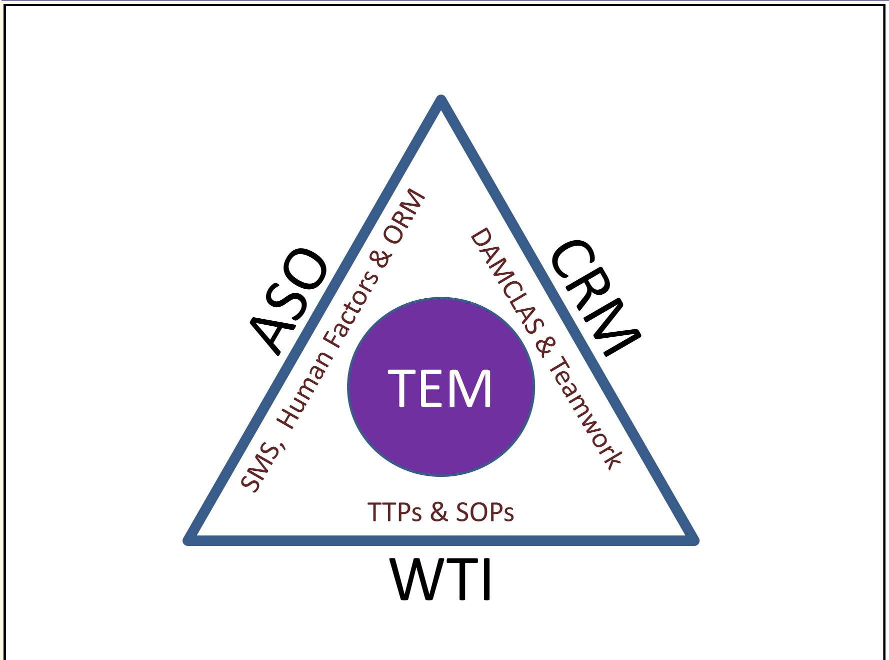

Figure 4. The mutual support of the people and programs within the Threat and Error Management (TEM) framework. Resources combine in the aviation unit to combat both Blue and Red threats.

<u>Summary</u>

TEM is a methodology that addresses TCRM in the dynamic environment of Naval Aviation. If we adopt and routinely practice TEM as much as we practice Red Threat TTPs, we will have more effective combat aircrews. TEM puts aircrews on a more proactive stance against the Blue Threat, putting in their frontal lobe the thought, "what is going try and kill me today?" I like to use the analogy of a man seeing a bear near the Grand Canyon. The man sees the bear as a threat, but only sees the log as a trip hazard. In his haste to get away from the bear he trips over the log and falls to his death down the side of the canyon. Moral of the story? Our myopic view of what is a threat can lead us to trip over hazards….

—CAPT Jody "Caveman" Bridges, USN—Director; *jody.g.bridges@navy.mil*

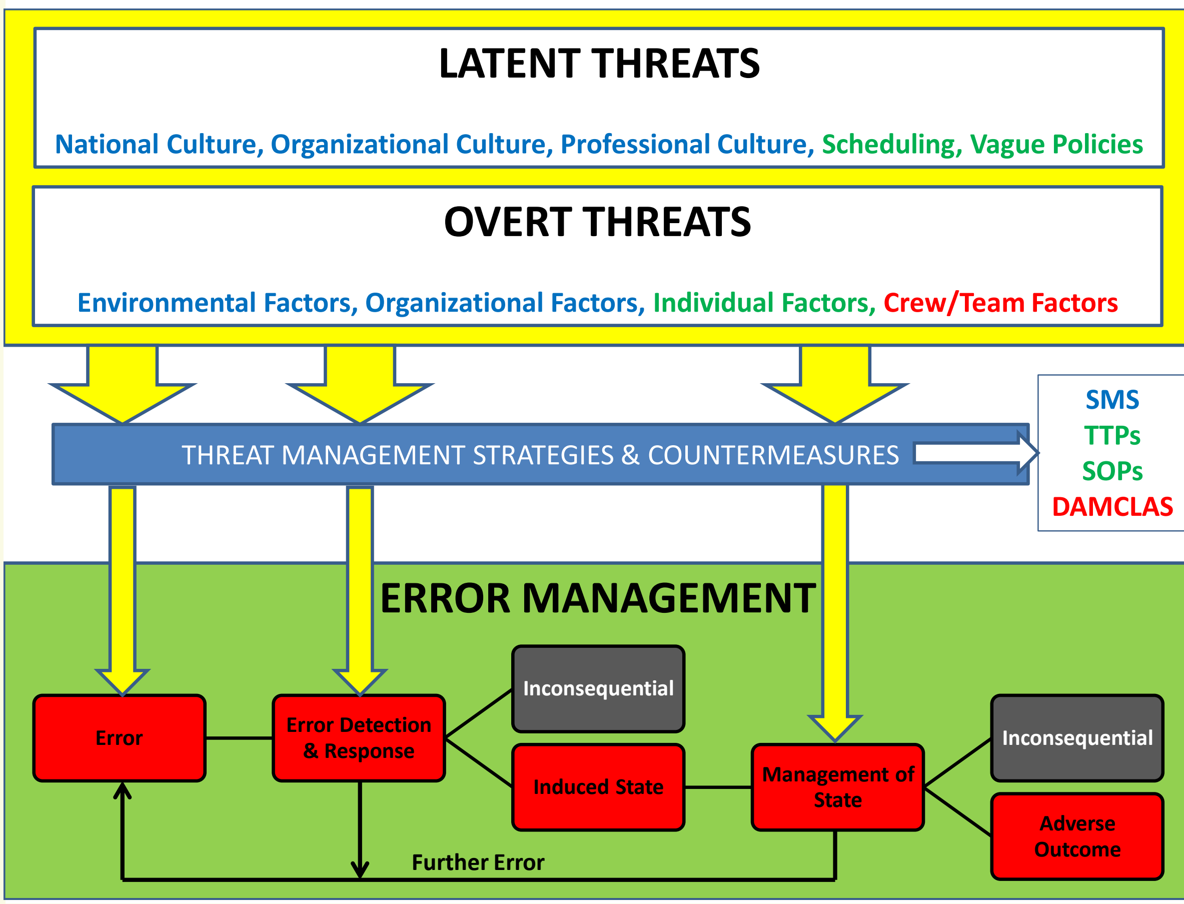

Figure 5. (left) The process of combating the Blue and Red Threat with the ASO-WTI-CRM team. Blue text denotes ASO targets; green text denotes WTI targets; red text denotes CRM targets. Each team member utilizes specific strategies and countermeasures to combat the threats and support the error management process.

MAN — *DODHFACS UPDATE*

When you were here at ASO School, we spent quite a bit of time on the history of how we arrived at the Department of Defense Human Factors Analysis and Classification System (DoDHFACS) model. You may recall that we started with the Mishap Triangle developed by William Heinrich in the 1930s, and went through the 3M and 6M Model development that took nearly 30 years. Next came the SHELL Model, and then James Reason's sentinel book on Human Error that was written in 1990. The next big event was the work of Drs. Scott Shappell and Doug Wiegmann in the mid-1990s, as they developed the original HFACS Model that contained 20 large bins (boxes). Shortly after that, other Human Factors specialists developed the nanocodes that are in the large bins (boxes) of what then became known as the DoDHFACS Model. The original DoDHFACS Model had 147 of these nanocodes, and the language was relatively scientific and aviation-centric.

As the generic HFACS Model grew in popularity, many civilian organizations developed their own versions. There is a DoDHFACS Working Group that is tasked with modifying the military DoDHFACS Model when necessary. Well, the time for modifications has come. All of the five military services want to use DoDHFACS as the standard human factors classification system. Not only that, they want to be able to use it for surface, submariner, and ground mishaps, as well as off-duty mishaps. In order for this to be accomplished, the model had to be modified so that it was no longer aviation-centric. However, we did not want to lose the aviation data that was collected over previous years.

We are happy to report that after many days of hard work, a group of human factors specialists and operators (pilots, NFOs, etc.) from all five services came up with a major draft revision to the DoDHFACS Model. In the draft, four of the original large bins (boxes) were removed, but one new one was added. The 147 nanocodes that currently exist were reduced to 107. The language was all redone to be easy for the "Average Joe" to use, and it is no longer just for aviation.

The five military services were briefed on the draft DoDHFACS 7.0, and we are awaiting final approval. The next big step will be to ensure that all five services are teaching the model the same way. As you know, Navy, Marine, and Coast Guard aviators are all trained here at the Naval School of Aviation Safety, but we need to be sure that the Army and Air Force train their people in the same manner we do. A draft of the new model is on the following page. After rigorous testing, the working group hopes to be able to make this revised model available some time in 2014. We will, of course, keep you updated with the progress in the coming months.

The tall ship Bounty was photographed from a Coast Guard aircraft just before the vessel sank off North Carolina in October 2012, killing the captain and a crew member (NTSB photo). "It was an end to a voyage that should not have been attempted. To set sail into an approaching hurricane introduced needless risk" (NTSB Report). USCG C-130 & H-60 crews flew into the hurricane to save 14 lives.

—Mr. Bill "Pop" Little, CDR USN (retired)—Human Factors Instructor; william.l.little@navy.mil

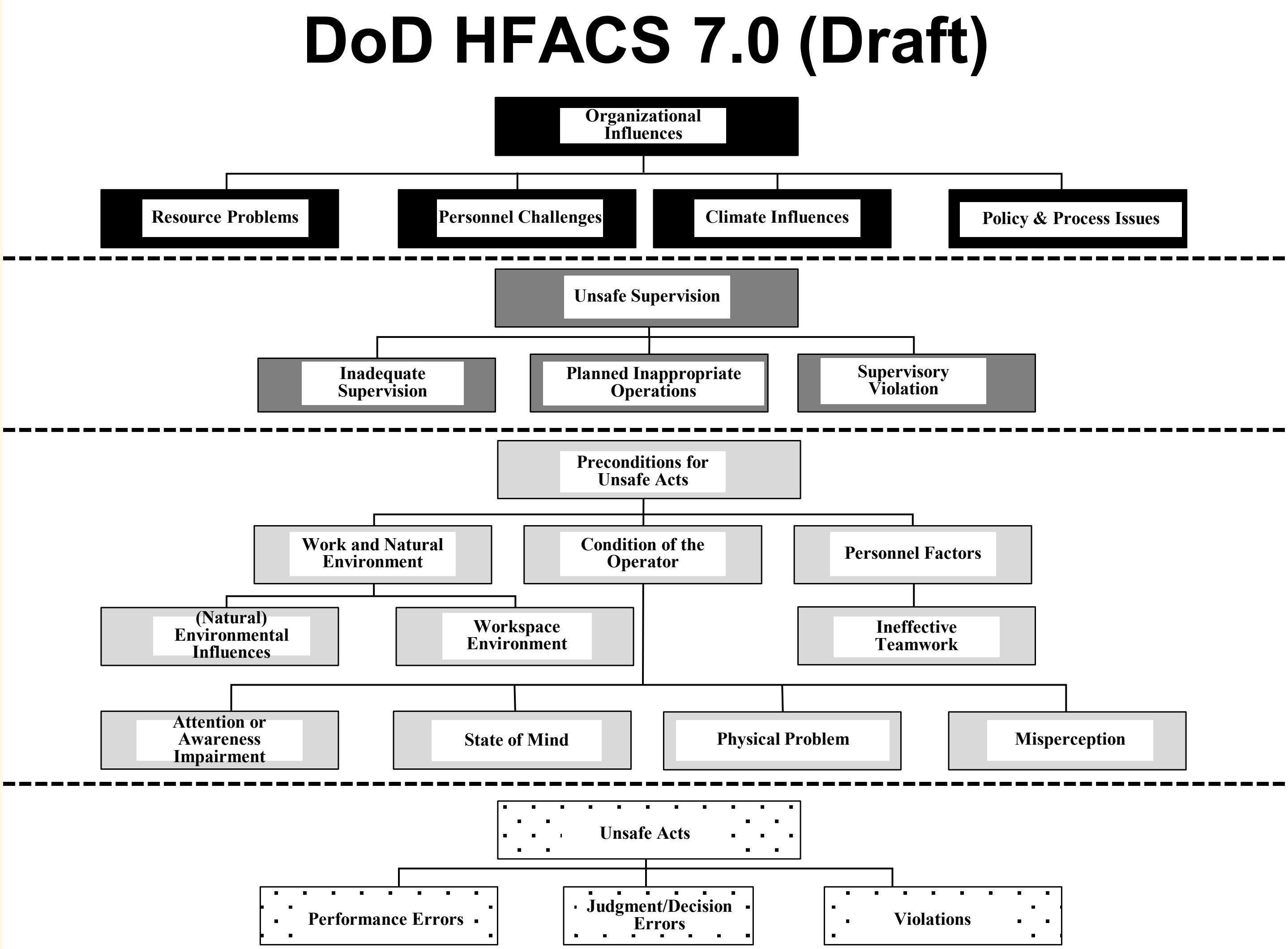

Figure 6. DOD HFACS 7.0 Draft. Note: Only the 2nd tier bins are depicted for each level due to space. There are more bins included in the Preconditions level.

The Joint Service Safety Conference consists of safety leadership representing the services shown below

MEDIUM — *HAVE A PLAN!*

Picture this. You and your XO are flying an aircraft to a detachment site. You were a member of the Det OIC's planning team and you know the det pack-up kit has everything you need to do your job as the Det ASO, so you are thinking ahead to some of the qualifications you will be completing. As you enter the terminal phase of flight, you experience a flight control degrade, which you and the XO handle in accordance with NATOPS and then proceed to land. On landing, the flight controls again degrade, resulting in controllability issues on the runway. The two of you get the aircraft stopped, albeit no longer entirely on the prepared surface, and the aircraft ends up with estimated Class B damage. What now?

Clearly it's time to convene the Aviation Mishap Board (AMB), but 40% of it was involved in the mishap! By the way, your flight surgeon (FS) is back at home field because he or she is currently responsible for multiple squadrons, and clinic duty on top of that. Now you have to scramble to scrape together an AMB while the SDO is dutifully executing the Pre-Mishap Plan (PMP), which means he or she is pushing YOU out the door, along with the XO, to provide blood and urine samples at the base clinic. If right now is the first time you are thinking about this kind of contingency, you are behind the power curve.

<u>Stay Ahead of the Curve – Be a Planner</u>

This entails more than just your 30-60-90 and annual training plan. To be a truly effective ASO, it is incumbent upon you to take part in your squadron's planning process so that your efforts to prevent mishaps fit seamlessly into the life of the squadron. While you are busy preventing mishaps, you also have to prepare your squadron to respond to one. You need to support the Det OIC with an accurate, tailored PMP. You must ensure the SDOs and ASDOs know how to execute it. You also need to know who is going on the det, so you know where your standing AMB members and their back-ups are. You did designate back-ups, right?

Maybe it's a big enough det that the entire AMB is going. Keep in mind, though, that if there are aircraft back home, you need to have a plan for how to respond to and investigate a mishap there. Perhaps your squadron is one that sends a single aircraft with a couple of crews and a small maintenance team halfway around the world. If that aircraft has a mishap, half of the det is the subject of an investigation, and the other half is conducting it (because they've been trained – by you), at least until the standing AMB arrives. It goes beyond that though, because priority number one, the mission, is not happening. If you've taken the time to think this one through, you'll have a better chance of conducting an effective investigation while also getting the aircraft back to an "up" status in order to meet mission.

We talked about building external relationships during the Programs lecture series and here is where that can pay big dividends. If you've arranged for a Senior Member-eligible O-5, ASO and FS at the det site to provide contingency support, you already have 60% of an AMB should the worst happen.

<u>Get It Down On Paper</u>

None of this planning actually happens unless you document it. Once you have formulated your contingency plans and they've been reviewed and approved by the Det OIC and the front office, make sure they also get into the Det Letter of Instruction (LOI) and PMP. Include contact information for any of the external support personnel you've arranged and the roles these people are expecting to fulfill. This prevents you from being the single point of failure – remember, you're being shuffled off to the clinic. Anyone can pick up the LOI or PMP and determine who to call (over).

MEDIUM — *HAVE A PLAN!*

Bottom Line

It's all about taking care of your squadron. This is what leaders do – think ahead, build relationships, make contingency plans, and leverage available resources, all while doing things right and setting the example. This ensures the success of the mission. It may take a little imagination and critical thinking to envision some of these solutions, but those are skills you have, ASO, so put them to work!

—LCDR Mike "Spock" Chenoweth,—Programs Instructor; michael.chenoweth@navy.mil

MACHINE — *HIGH ALTITUDE STALL*

High altitude stall? So what? Is this really even a hazard? So what if I stall at 20,000 or 30,000 feet? Typically we are much more concerned with stalls at low altitudes, and rightly so. But that in itself is one of the reasons a high altitude stall can be a significant hazard – typically it's something we don't really think about.

Why is it a hazard? A high altitude stall can be one contributing element to the chain of events causing a mishap, a catalyst that when combined with other holes in the Swiss cheese, will lead to a mishap. In 2004 a Bombardier CL-600 from Pinnacle Airlines crashed after the aircraft stalled at 41,000 ft. The stall caused both engines to flameout, neither of which the aircrew were able to restart and eventually crashed after failing a last ditch effort to glide to an adequate runway. Though there were multiple failures in procedures and communications throughout, the initial stall event set the whole sequence in motion. A more recent accident, Air France Flight 447, initiated as an iced-over pitot tube, resulting in an autopilot disconnect and temporary loss of airspeed information. The pilot at the controls, inexperienced at handling the aircraft at high altitude and unaware of the differences in stall characteristics, stalled the aircraft and never realized they were stalled until it was too late to recover.

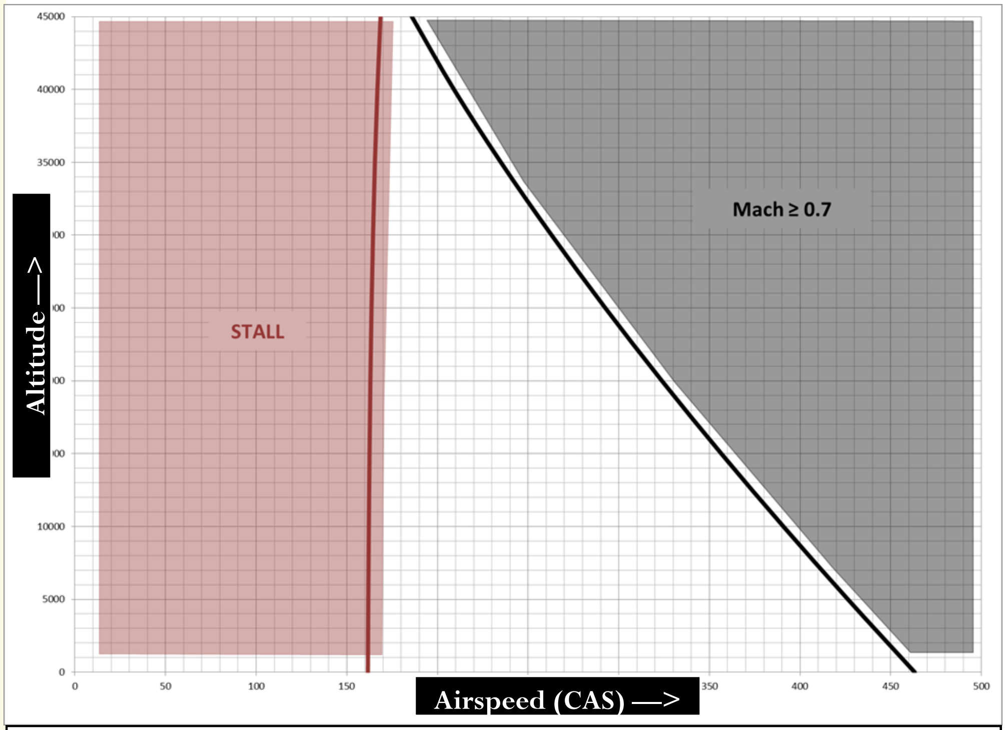

Figure 7. Stall speed (CAS) and high Mach number vs. Altitude

So what is different about stalls at high altitudes? Don't we say that stall speed is a function of angle of attack and that stall AOA is only dependent on the shape and configuration of the airfoil/wing? Altitude changes density, but if I fly indicated or calibrated airspeed shouldn't the density changes not affect my stall speed? All this is true… to an extent. It is true that the change in atmospheric density due to altitude will not change my indicated/calibrated stall speed (only TAS), however that's not the whole story. What we don't usually take into account (because in most cases it's minor) is two other variables that affect the stall AOA of the aircraft: Machnumber (M) and Reynold's number (Re).

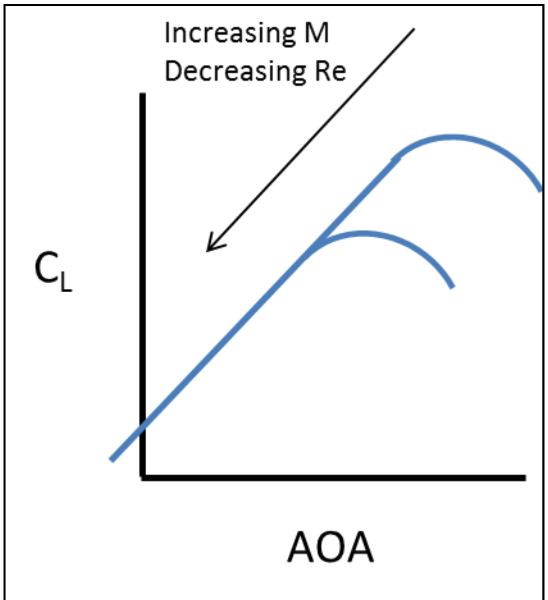

Figure 8. Effect of Mach and Reynold's number on stall angle of attack

Mach number. At a high Mach number, in the transonic flight regime (M > ~0.7) the compressibility of the air changes the pressure distribution of an airfoil, causes an increase in separation, and changes (decreases) the stall AOA of the aircraft. In most cases the effect of Mach number is irrelevant, because who cares about a high speed effect on a low speed issue? How can I be in the transonic flight regime near my stall speed? At sea level and low altitudes this isn't possible. However, at high altitude (extremely low temperatures) the speed of sound is decreased significantly. Compressibility effects, shocks, etc. don't care how fast I'm flying; they care how fast I'm flying in relationship to the speed of sound. So when the speed of sound is low I can fly slow and still be at a high Mach number. Figure 7 illustrates the shrinking buffer between transonic flight and the standard (i.e. not including Mach effects) stall speed.

Reynold's number. To say stall angle of attack is independent of altitude also neglects the effect of Reynold's number. Reynold's number is essentially a ratio between the inertial forces and viscous forces in fluid flow. One way to think of Reynold's number is the relative viscosity or "thickness" of the flow (hot oil vs. cold oil). At high altitudes the Reynold's number decreases (increasing the viscous effect) which decreases the energy in the boundary layer and causes separation to occur at a lower angle of attack.

The importance of this discussion is to understand that flying at a high altitude even at a high true airspeed, the aircraft may still be very close to stall speed/AOA. In both of the civilian mishaps above, experienced pilots were unaware of the differences in high altitude stall and the danger it presents. Automation, and increasing dependence on automation, only add to the hazard. Though a seemingly insignificant and rare situation, high altitude stall is commonly misunderstood, and therefore presents a significant hazard. An increasing awareness of this hazard and understanding the aerodynamics involved are important to avoid this uncomfortable and dangerous situation.

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Winter Milestones in the U.S. Sea-going Services

- *January 20, 1914: Battleship USS Mississippi (BB 23) arrived in Pensacola Bay to set up the Navy's first flying school on what is now Naval Air Station Pensacola..*
- *February 13, 1917: Captain Francis T. Evans, USMC accomplished 2 loops in a seaplane, then forced it into a spin and recovered it safely, defying most experts of the time and earning himself the Distinguished Flying Cross.*
- *January 3, 1944: CDR Frank Erickson (CG Aviator #1) flew the first helicopter rescue mission, delivering blood plasma lashed to the floats of his Sikorsky HNS-1 after an explosion aboard USS Turner left dozens wounded.*

To maximize the utility of Naval Aviation safety reports, we as professionals must create a culture in which it is OK to make mistakes and talk about them. This is a sound "reporting culture." This is frequently done at the squadron level with the use of programs like "true confessions." "True confessions" provides a forum where aviators and others can admit to mistakes without repercussions. This allows for the command to discuss these events, learn from them, and sometimes, to assess how to ensure they are not repeated in the command. Overall, this is a great program when it works correctly, which is when leadership provides a climate in which members feel safe providing information about how they could have better executed a mission. The problem is that often the learning and action stops within that command. There are many times when this information could benefit others in the community or throughout Naval Aviation. These are opportunities for Hazard Reports (HAZREPs).

There are many barriers to releasing HAZREPs within the fleet. The question often arises as to whether something is even HAZREP-worthy, or just the proverbial airing of a squadron's dirty laundry. The question is a simple one to answer. Could the event or situation lead to injury or damaged equipment? If so, a HAZREP is warranted. I have recently heard people talking of flooding the system. Certainly WAMHRS can handle all of the reports we can throw at it, but there is another side to this comment. If there is too much information out there, will people read any of it? This is certainly an important question to answer because if those writing the reports don't think they are useful they won't put the time they should into them. Regardless, someone will read them. The people that should and will read them are the same safety professionals that are writing other HAZREPs (ASOs). They support "informed cultures." This is evident in communities that write a good number of HAZREPs compared to some communities that rarely put HAZREPs out.

There is more to reporting these hazards than just sharing the information with your communities or other squadrons. It is important to document hazards in order to discover trends and prioritize funds. Proper hazard reporting can be a leading indicator of what the next mishap will be. This facilitates the "learning culture." Which holes in the Swiss-cheese model did we find empty and, just as important, which holes were full in order to prevent that incident from becoming a mishap? If we are not capable of reporting these incidents and reading those of others, then we will repeat errors and not mitigate the risks of aviation to the best of our abilities. This highlights another important duty of an ASO—to filter and present pertinent safety reports to the squadron in a digestible manner.

It is critical that we create a culture in which it is safe and acceptable to talk about our mistakes. This is the responsibility of leadership in Naval Aviation. If leaders frown upon or ask "what the heck are you guys doing over there?" whenever a squadron puts out a human factors HAZREP, then squadrons will stop reporting. However, if the leaders say, "hey, great HAZREP on …" in public, then other squadrons may choose to put an emphasis on reporting hazards too. Similarly, if a CO praises JOs for speaking up during "true confessions" then more buy-in will occur within the squadron. The bottom line is we all play a role in creating the culture. Let's ensure we are creating the best culture for success, which I believe is one in which we can safely tell our mistakes to each other, so we don't continue to make them.

U.S. Navy photo by Mass Communication Specialist 2nd Class Jared King/Released

—CDR Jeremy "Ricky Bobby" Niles, USN—Reporting Instructor; jeremy.niles@navy.mil

CRM — *DIAGNOSING CRM QUALITY IN THE READY ROOM*

Since its inception, Crew Resource Management has become a staple of Naval Aviation training. From their first days in the training pipeline, Student Naval Aviators (SNAs) and Student Naval Flight Officers (SNFOs) and Aircrew are introduced to the basic tenets that make up the focus of CRM: If you rigorously practice and use the 7 Skills of DAMCLAS, you are more than likely going to come home with your crew and your aircraft in the appropriate number of pieces.

The CRM Program, as it is currently set up, is a type of Counter-insurgency strategy aimed at combating the continuous and sometimes insidious Threat that Human Factors failures pose to effective mission completion. At the CRM School, the Instructional Model Manager (IMM) trains the CRM Instructors (CRM-I's), who train the CRM Facilitators (CRM-F's), who train the units and their members. A little ink spot here in Pensacola travels a long way to the fleet. But, because we are a large air force, the most salient points from CRM-I training sometimes get lost in that particular telephone game. As a preventative measure, the Managers of the CRM Program are required to inspect the programs for each type/model/series of aircraft in the Navy and Marine inventory. On a regular basis, we meet with those Program Managers, located (mostly) at each Fleet Replacement Squadron, to assess the quality and depth of their efforts at making CRM the standard Operating System.

While the fleet has certainly gotten a good grasp of the impact of fundamental CRM Principles, the program's integrity suffers when there are gaps in adherence to its requirements. Akin to looking at a mirror through a mirror, or better yet, the iterative nature of a fractal landscape, it's smart for us to take a macro look at the program's successes and failures through the prism of the Seven Skills. The Instructors here at the School have always understood and taught that there is a fundamental interrelationship between the skills. Each one is fatally dependent on the other six for its success. None can exist without a strong link to all of the others. Because of this relationship, it's nearly impossible to make a case for the preeminence of any one skill over another. For example, to those who put forth Communication as the most important skill, I say: "How good is your Communication going to be if your SA is flagging, or if you are up against an over-assertive (co-) pilot?"

We understand however, that like most human endeavors, maintaining the standard requires, in addition to eternal vigilance, an acceptance that we may not always meet every standard, all the time. Ideally, every aviator, flight officer and aircrewman would maintain peak levels of each of the 7 Skills throughout every evolution. An understanding of Human nature quickly dispels that notion, however. The sheer number of internal and external influences that act upon an individual to lower their performance in a given situation ensures that the attainment of 7 Skills perfection is always an uphill battle. What we have found is that, while most programs have a robust culture at the FRS level, that doesn't necessarily always translate to the Squadron level. Sometimes, this is due to inconsistent or incomplete communication with Unit Level Managers (ULM's). Sometimes, it's due to the sheer number of squadrons flying a particular T/M/S. What seems like a small, programmatic communication failure turns into a systemic problem whereby the ULMs have to start freelancing their training, or worse, just let the quality of that training suffer. Either way, standardization of best CRM practices declines. Putting it in terms consistent with CRM training, that decline, if left on its own, constitutes a latent Threat to safe and effective mission completion. As the CRM Instructional Model Manager (IMM), we're here to manage that Threat.

Perhaps a more pragmatic view of how the Skills work together is required.

The IMM is currently working on a Unit Level tool that could possibly assist Commanding Officers in the qualitative analysis of their current CRM state. So as to not encumber their Safety and Operations Departments with new programmatic requirements, the tool uses the already existing Human Factors Council (HFC) process to solve CRM deficiencies discovered in an anonymous (regularly scheduled) peer assessment. With the assistance from the Navy's Aviation Experimental Psychologists, the assessment, designed to gauge the average quality of each individual's skillset, can be mapped to the standard Aircrew types found in the HFC instruction. The Council, if moved by the assessment, and in concert with other potential Human Factors, has the ability to mitigate that threat by the use of the HF fixes prescribed in the HFC instruction. With a flexible periodicity, the cycle can look like Figure 9, on the next page.

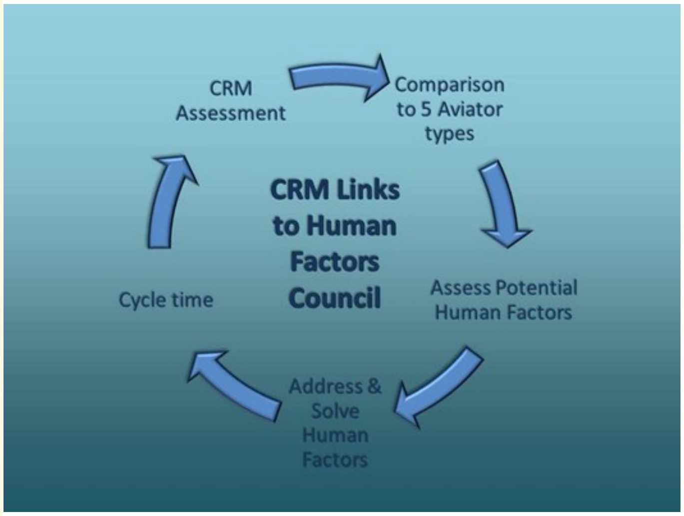


Figure 9. CRM and Human Factors.

If we were to imagine the 7 Skills looking like the individual satellite signals (Figure 10 below) that comprise a total GPS picture, we can imagine that, as the mission moves forward in time, the quality, or signal strength of each skill will ebb and flow depending on the requirements of the mission, the crew's readiness to perform it, or other outside factors. In any case, a degradation of any one skill lowers the total quality of CRM for that crew. The only way to maintain the overall "signal strength" is to understand where the gaps are and to bolster the signal with redoubled effort in other places. For instance, if an aircrew encounters a radio problem that precludes them from regular, clear Communication (CM) with outside agencies during a flight, that crew MUST make up for that communications deficiency, if it is going to successfully complete its mission. But, how? The answer lies in the other skills… Increased internal CM, so that everybody is working from the same playbook, better Mission Analysis (MA) as a problem solving tool that leads to Adapting and Flexing to a new plan (AF). There are myriad examples of how to use 7 Skills to get an aircrew out of a jam, but a concentrated effort to focus on increasing the quality of each of those skills is what raises the overall quality of that "signal." Additionally, looking at the requirements of a particular phase of flight, T/M/S, mission, or even time of day might give us insight into which combination of skill performance levels are optimum for each particular situation.

Take, for instance, a Communications emergency in a single seat aircraft with an inexperienced pilot- say, NORDO coming back to the boat… Figure 10, below illustrates the parallels. The skill level displayed in the left image, when viewed as a requirement, illustrates the "potential" level of CRM Skills required to complete the mission and return to the carrier safely. If the image on the right represents the pilot's overall CRM skill level due to his/her inexperience at the time of the emergency, then the probability of not completing the mission lies somewhere in the gaps between the illustrated skill levels. Giving a Commanding Officer the ability to project how well any of their aircrew will perform in a particular situation based on their past CRM performance, as seen through the peer assessment in conjunction with the HFC process, increases the likelihood that missions will succeed safely.

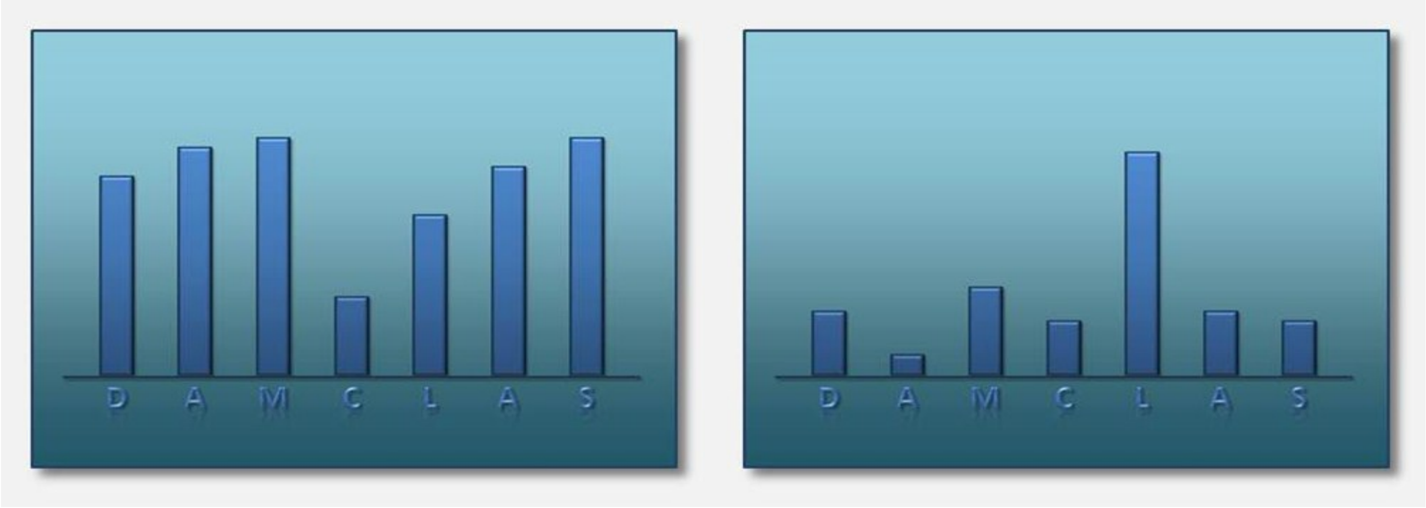


Figure 10. Seven Skills Signal Strength Variation.

CRM — *DIAGNOSING CRM QUALITY IN THE READY ROOM (CONT)*

As a final thought, the comments that punctuated the final endorsement of a recent Class A mishap have added the emphasis needed to underscore the importance of good CRM to effective mission completion.

"NATOPS and CRM training are not superfluous training requirements nor administrative burdens to be scheduled when they can be easily accommodated. NATOPS and CRM training are fundamental to successful operations and a professional requirement mandated by NATOPS to ensure the safe practice of Naval Aviation.

Sound decisions in an aircraft emergency do not occur by chance; they are the earned products of experience, strict adherence to NATOPS, full situational awareness, and effective practice of CRM."

The willingness for a command to consistently train to the standards of CRM and to properly manage Threats is dependent on seeing the results of that effort. The tools mentioned above are being designed to do just that. As we develop those tools, we invite input from the fleet to assist us in pinpointing which skills are most important to each of your mission sets.

LCDR Brendan "BTOB" O'Brien, USN—CRM Director; brendan.obrien@navy.mil

Quantico, VA, February 7, 2014, VH-3. U.S. Marine Corps photo (public doman), retrieved from http://www.marines.mil/Photos.aspx?igphoto=2000778696. Photographer unknown/released.

SPECIAL TOPIC — *ROOTS OF AVIATION SAFETY CULTURE: LEARNING AND LEADERSHIP*

> **"No one can defeat us unless we first defeat ourselves."**
> **—General Dwight Eisenhower**

It was a busy night in 1991. During several aircraft maintenance activities, the crew left the screws from the left horizontal leading-edge stabilizer for the next group to clean up. They will surely see and attach the stabilizer with the screws.

A quality assurance supervisor assisted one of the mechanics. The log entry: "helped mechanic pull boots." The busy staff members did not follow procedures exactly, but it wasn't out of the ordinary (National Transportation Safety Board [NTSB], 1992).

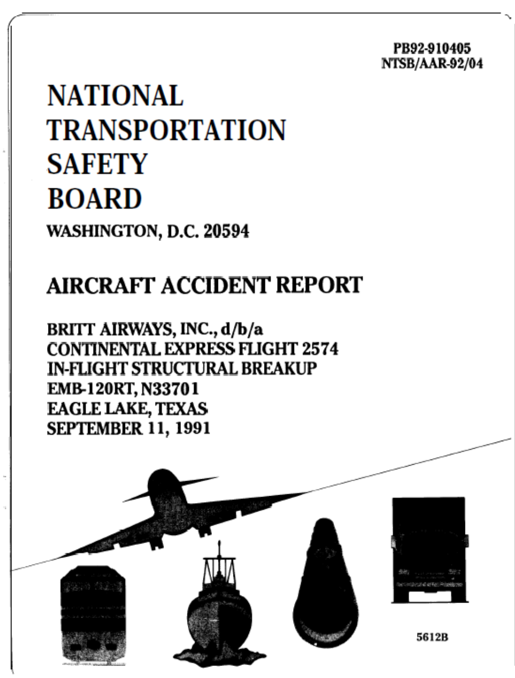
Poor communications between air traffic control and pilots led to a 1974 jet crash in poor weather near Washington, DC. Analysts found that six weeks prior, a United crew experienced similar circumstances and reported it to a newly implemented internal safety program. However, information from the event was not shared industry-wide (Guise, Lowe, & Connell, 2008).

In the first example, notice the normalization of deviance. In the second, you might see a lack of structure. With both examples, dedicated aviation professionals were doing their job, but something still did not hit the mark. How can we learn from these examples?

I want you to consider your paradigm regarding two things: (1) following procedures, and (2) hazard reporting. Do you consider safety a reactive or proactive business? Do you know that everybody has a role in a growing safety program? What will YOU do to prevent the hazard that could lead to the next mishap?

Imagine your most trusted mentor, friend, or colleague asking you two questions regarding safety: (1) how do you **learn**, and (2) how do you **lead**?

NTSB investigators of the Embraer EMB-120 crash at Eagle Lake, Texas found the leading edge of the left horizontal stabilizer was missing several screws. The part suddenly came off during descent. Due to the resultant control forces the aircraft was rendered uncontrollable. Fourteen people on board died.


PB92-910405
NTSB/AAR-92/04

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

BRITT AIRWAYS, INC., d/b/a
CONTINENTAL EXPRESS FLIGHT 2574
IN-FLIGHT STRUCTURAL BREAKUP
EMB-120RT, N33701
EAGLE LAKE, TEXAS
SEPTEMBER 11, 1991

5612B

Why did it make sense for the maintenance staff to perform their jobs in such a way that a critical flight component was not properly installed?

In his seminal dissenting opinion following the board's work, NTSB member John Lauber wrote the following statement (paraphrased for context): "…the probable cause of the accident was failure of management to establish a culture which encouraged and enforced adherence to procedures" (NTSB, 1992).

According to the 2013 Safety Management Manual published by the International Civil Aviation Organization (ICAO), our profession has transformed from a focus upon technical factors into the 1950s, to human factors in the 1970s, to the era of organizational factors in the 1990s (ICAO, 2013).

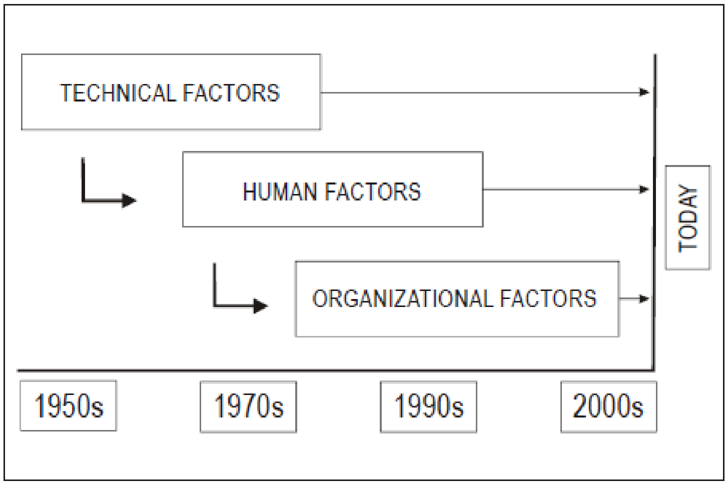


Figure 11. *The Evolution of Safety*, adapted from ICAO Safety Management Manual, 3rd Edition, 2013.

The father of the "Swiss cheese" model, James Reason, extols five principles to promote a culture of safety (Reason, 1997). I have elaborated on his definitions from a working group paper (Roadmap to a Just Culture, 2004) with my own perspective.

1. Just Culture. Atmosphere of trust abounds where people provide safety-related information. Clear lines are drawn and understood between acceptable and unacceptable behavior.
2. Reporting Culture. A climate exists where people are prepared and equipped to report errors and near-misses.
3. Learning Culture. Drawing accurate conclusions from the safety information system. Organizational will to implement reforms based on the conclusions.
4. Informed Culture. Safety system managers have current knowledge about factors (human, technical, organizational, environmental) that determine the safety of the system.
5. Flexible Culture. The organization reconfigures its hierarchy as necessary to adapt during high-tempo or extraordinary danger, and recognizes the hazard of normalized deviation.

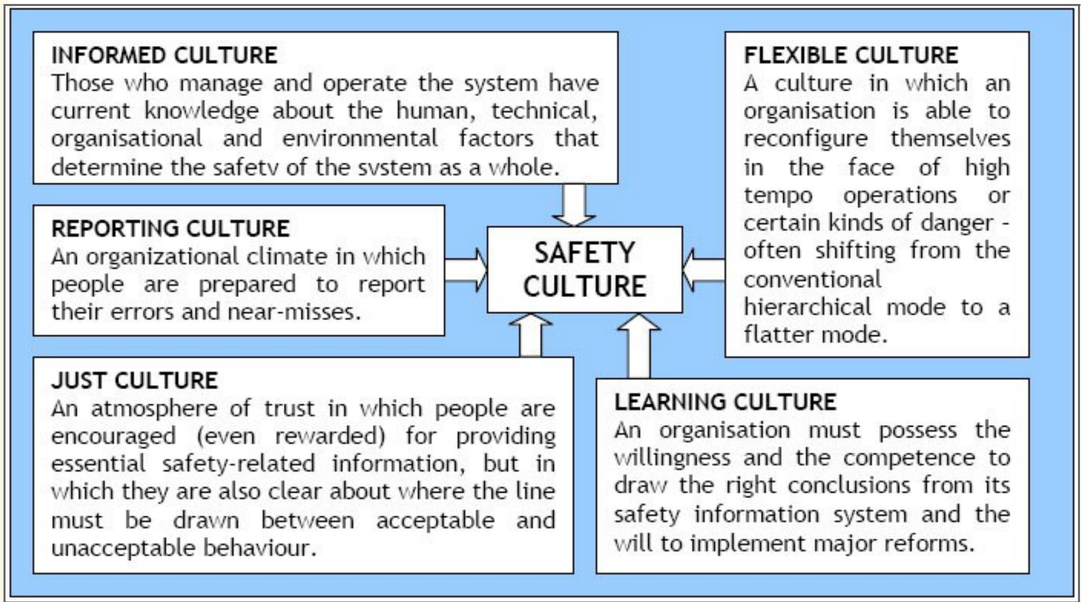


Figure 12. *The Components of Safety Culture: Definitions of Informed, Reporting, Just, Flexible and Learning Cultures*, based on Reason (1997) and adapted from "A Roadmap to a Just Culture: Enhancing the Safety Environment," GAIN Working Group E, 2004.

In safety, we can design a model safety management framework, but human participants in the system exhibit varied performance. How can we script the desired activities, and eliminate the hazardous behavior? Although many things contribute to aviation safety, let's focus on two main points: learning and leadership.

Learning: The central goal of a transforming safety culture is to gain buy-in so people can learn things the right way. We must provide a safe design for the system to function, empower people to learn then lead them in performing the mission. Sounds simple, right? Then why is it so difficult? (next page)

SPECIAL TOPIC — *ROOTS OF AVIATION SAFETY CULTURE: LEARNING AND LEADERSHIP (CONT)*

Looking back at the 1974 example, programmatic infrastructure was not in place to inform TWA pilots of the possible communication errors that a United crew had experienced a few weeks prior. Following the tragedy, the Aviation Safety Reporting System (ASRS) was established. Now aviators could report hazards into a central database from which everybody could learn lessons. For example, as a result of lessons learned from the 1974 crash, pilots and air traffic controllers established well-understood, standardized terminology.

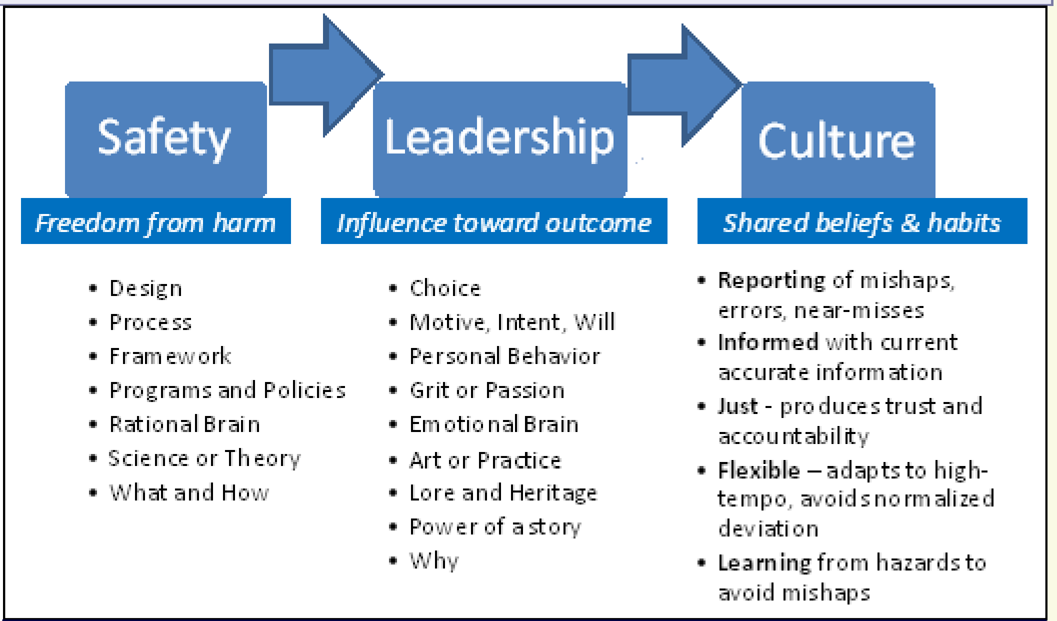


Figure 13. Relationships of Safety, Leadership, and Culture.

Despite the practice of reporting being around for over a generation, I would surmise that all hazardous activities or situations in your organization may not be reported. Would you agree? Why do we not report? Fear of reprisal? Laziness? Lack of infrastructure?

Regarding a culture of non-compliance in the commuter airline example, let's look in the mirror at how we're doing business. Has normalization of deviance become more accepted in our own shop? Before we jump on the bandwagon to punish those who have deviated, take a step back and consider a new and fresh look at the systems where people think it's okay to deviate. Let's revamp our reporting norms. Ask people to report deviations, and re-engineer the processes to get the information back out to the field for feedback.

Improving safety culture is hard work. Each system participant has a role and identity. Transforming safety programs engage, connect and align management with the workforce to harness the power of shared ownership and participation. The shared experience of learning is a team behavior founded on trust and informedness.

It's time to take the leap to exercise a new brand of leadership. The style of leadership that seeks to learn. We need to move from reacting to mishaps to becoming proactive with hazards BEFORE mishaps occur. From preventing harm to a new paradigm of building success.

Let's eliminate excuses and establish a healthy new dialogue between staff and management. What can we report and learn? How can we transform safety? Are we too busy to take a look and make the required changes that will transform our program? Tough questions.

For management, let's cultivate a new will to implement reforms based on accurate conclusions from our reporting and learning efforts stemming from aligned and engaged members operating in a trust environment. For staff, a renewed focus upon accountability to explore mistakes and errors as learning opportunities. (next page)

I believe strongly in the bedrock of leadership to anchor our profession. Leadership at all levels that does not dictate, but instead serves, fosters, and listens. Leadership to build and perpetuate trust. Expected byproducts of these efforts include participation, buy-in, and ownership.

We must lead in such a manner that produces an outcome that all hands exercise leadership as a regular practice. In doing so, we learn both as individuals and organizations.

Choose leadership!

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The Naval School of Aviation Safety would like to thank Captain Mitch Morrison, USCG for generously contributing to the Winter 2014 Safety Sigma. We encourage commanders, safety leadership, ASOs, FSOs, and others to contact the editor (information on the last page) if you have interest in submitting written work to future issues.

NORTH BEND, Ore. - Coast Guard Master Chief Petty Officer Frank Allard arrives dressed as Santa with an HH-65 helicopter crew.

US Coast Guard photo by Petty Officer 3rd Class Nate Littlejohn.

U.S. NAVY AND MARINE CORPS SCHOOL OF AVIATION SAFETY

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Also, if you would like to be removed from future emails, please email LT Bates (info above) with name and approximate dates of your class attendance.

(Below) The P-8 crew visiting the SAS crash lab

(Above) A new Navy P-8 visited NAS Pensacola in January, 2014. Personal photos (above and right) of LCDR Michael Chenoweth, USN, used with permission

SPECIAL POINTS OF INTEREST

"DOC" BANK MEMORIAL DISTINCTION: STUDENT RECIPIENTS

The *Milt "Doc" Bank Memorial Distinction*, recognizes the student or students in each graduating ASO class who best exemplify the characteristics of the late, great Milt "Doc" Bank, PhD: motivation, intelligence, imagination and aptitude to be a potential future ASO Instructor. The recipient of this award for ASO Class 14-1 was LCDR Jarrod Trant, USN. The recipient of this award for ASO Class 14-2 was LT Shawn MacEwan, USN. Congratulations!

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